

## Parking and Traffic Improvements for Tirupati City Streets

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### ABSTRACT

*Transportation is the key infrastructure of a country. A country's economy status depends upon how well the country is served by its roads, railways, air ports, ports, pipelines and shipping. The rate at which a country's economy grows is very closely linked to the rate at which the transport sector grows. As road transport gives personal mobility to persons, the vehicle ownership rate has been increasing at a fast rate round the world. Due to increase in car ownership, the problem of parking is becoming more and more acute day by day. Vehicles may be parked on the kerb side but it creates lot of problems like congestion, jams, accidents and also reduces effective road width. This parking is causing some major problems that are created by the increasing vehicle traffic. Some of the issues related to parking are congestion, delay, accident, pollution etc. It has an impact on transport development. The availability of less space in urban areas has increased demand for parking space especially in central business area. Acute shortage of parking facilities is being felt in shopping centres, public places and official complexes.*

### Introduction

Economic and population growth have led to the rapid urbanisation and development of Metropolitan City. As a result of the rising level of development, the demand for local amenities such as on-street parking for developments adjacent to transport corridors has increased [1]. However, the process of the community utilising on-street parking can reduce road capacity as well as the achievable driving speeds for the roads adjacent to developments. Accordingly, traffic delays are a common experience in most of the urban transport

corridors due to the complexity of the interaction between traffic flow and land use. To date, literature has not presented a comprehensive study quantifying the impact of on-street parking on traffic flow within the City Metropolitan area and this study aims to fill this gap [2].

Parking is a critical component of transportation policy and management for any locale, but especially for the large central cities. The policies and management practices affecting parking lead to outcomes that, in turn, can affect land use, air quality, traffic congestion, travel behaviour, safety, and economic development, not to mention revenue lines. For example, policies that provide large amounts of unpriced parking may encourage automobile use, thereby increasing congestion. Effectively managing parking is an ongoing battle for the large cities as they face competing, and sometimes contradictory, objectives along with an ever-increasing demand for space. As important as parking is, however, there are relatively few serious analyses and assessments of parking, and even fewer of "on-street" or "curb" parking. Worse, because the interplay between on-street parking and other objectives (such as land use or economic development) is not well understood, policies are sometimes misguided or opportunities are missed to utilize parking in ways that could have positive impacts. Recognizing the need to develop both a body of literature and an ongoing peer-to-peer exchange about on-street parking [5].

**Cite this article as:** S.Mohisina Tayyiba & K.Giridhar, "Parking and Traffic Improvements for Tirupati City Streets", International Journal & Magazine of Engineering, Technology, Management and Research, Volume 5 Issue 5, 2018, Page 48-55.

### **The Importance of On-Street Parking**

On-street parking is a key factor in promoting businesses in cities, particularly within central business districts. As a kind of shared parking, on-road parking is an effective means for enabling various clients to use a similar space at various circumstances to achieve different goals. On-road parking gives simple access to organizations situated on city lanes and possesses less land per space than off-road parking which requires get to paths notwithstanding parking spaces [6]. For people on foot, on-road parking makes a barrier between moving activity and people strolling on the walkways, giving a measure of wellbeing and decreasing the level of apparent clamour. Further, contingent on how on-road parking is arranged on a road, it can likewise fill in as a movement quieting gadget, along these lines diminishing mischances or possibly making them less extreme.

However, on-street parking is not without trade-offs. A similar boundary between moving activity and people on the walkways can likewise make visual blocks for the two people on foot endeavouring to cross convergences and vehicles moving along a road, subsequently expanding mischances [7]. On-road parking likewise contends with different employments of roadways, including extra paths for activity stream, bicycle paths, and more extensive walkways. Further, as drivers search for open spaces, congestion on roadways is increased. Finally, on street parking, like all forms of parking, attracts vehicles, which generates mobe traffic. In fact, for large cities trying to increase transit ridership, availability and pricing of on-street parking become critical tools.

### **Parking types**

Parking research in the literature may be categorised generally as focussing on origins and destinations.

Research at origins considers a range of issues including uncontrolled and controlled parking, parking management methods, such as e.g. Controlled Parking Zones (CPZs), Residential Parking Zones (RPZs) [8]. Research also considers parking availability and

standards at existing and new private residential developments and car-free settlements etc.

### **The types of parking to be found at origins varies:**

- Private off-street parking;
- Public off-street parking (short stay, long-stay, contract);
- Controlled (paid) on-street parking; and
- Uncontrolled (free) on-street parking.

### **The Impacts of Parking**

The impacts of parking with regard to various planning objectives, include:

- parking supply (how much parking is provided in an area);
- parking prices (whether users are charged directly for parking, and the price structure used);
- travel patterns (the amount of vehicle traffic generated and use of alternative modes;) and
- Parking Research Review

### **PARKING MANAGEMENT OPTIONS**

Although each neighbourhood is unique, several parking issues and potential solutions are the same. The challenge is to provide adequate parking to meet a community's needs for mobility and economic strength, to encourage people to use other modes of travel, and to minimize the impacts of parking on neighbourhood character.

The following recommendations outline several parking solutions to consider in order to create a parking management system capable of solving existing and future problems [9].

### **Prioritizing funds**

Devoting land and funds to automobile parking often reduces the resources available to support other non-auto modes. As a result, policies that increase parking supply tend to reduce overall transportation choices. Consider long-term commuter parking needs versus short-term. A functional and financial analysis of

constructing a parking garage or long term surface lot would yield important information for the area as it plans for new development rather than solving the existing condition. Improve information for motorists. Create signs, brochures and other information resources indicating parking availability and price. Reduce automobile dependency and encourage transportation alternatives. Improve availability and accessibility of public transport including bus stops and discounted bus fares [10].

Increase the range of parking convenience and price levels available to consumers. Strengthen parking enforcement by developing more convenient payment and time options. Share parking facilities. Parking can be shared among different business in an area to take advantage of different peak periods. Encourage businesses to share parking. For example, businesses with no night-time hours can make their parking available for those that have night-time hours. Park once and walk. Focused on centralized, shared parking that will create a "park once, then walk" environment. This is the key in promoting businesses in cities, particularly within central business districts which allows multiple users to reach multiple destinations [11].

#### **Mixed-use parking**

Require shared parking in mixed-use developments and in mixed use areas, since peak demand periods occur at different times.

#### **METHODOLOGY:**

**The First Phase:** The first phase of the study was a preliminary attempt to gather various information and secondary data in registered vehicular population from various sources. The data covered geometry of the roads, Traffic volume, vehicular population, location and parking space information, parking rate (day and night), passenger car unit (PCU) [12], Time wise variation of PCU, purpose of parking at different parking space in the city of Tirupati. The information has been collected from the manually by surveying.

**The intermediate phase:** After collection of data it was used to calculate parking accumulation, parking supply, parking congestion scenario and outputs were tabulated for further analysis.

**The final phase:** After the collection of primary and secondary data, computation, tabulation and analysis of the same have been done. In this phase, data have been processed to prepare relevant graphs and best methods were suggested to maintain on street parking. Willingness to pay survey will also be done to solve the parking problem [14].

#### **STUDY AREA**

This study is confined to the city of Tirupati. In order to understand the parking behaviour and mode of choice of motorists with respect to shopping as well as work trips in the city of Tirupati, survey have been conducted at Five major roads including three busy traffic intersection points and two very popular shopping arcade in Tirupati. In Tirupati, it has been selected one busy market point which is Gandhi road followed by Prakasam road. Other locations that have been selected and these Air bypass road, Tiruchanoor road and V.V.Mahal road.

However, traffic volume was studied on six slots from morning to night for every one hour. Parking criteria was observed for the same six slots. Based on the obtained data and geometry of the road parking supply was calculated and it is compared with parking accumulation. Temporal studies were done at peak and lean hours of traffic to obtain the best variation [13].

#### **SPECIFICATIONS OF ROAD GEOMETRY**

The specifications of the road geometry those found are width of the road, stretch of the road, gradient if any, Shoulder width, Number of lanes and divider width all have been tabulated and presented here.

#### **ROAD MAP OF LOCATIONS WHERE STUDY IS DONE**

**Name of the Road: VV MAHAL ROAD**

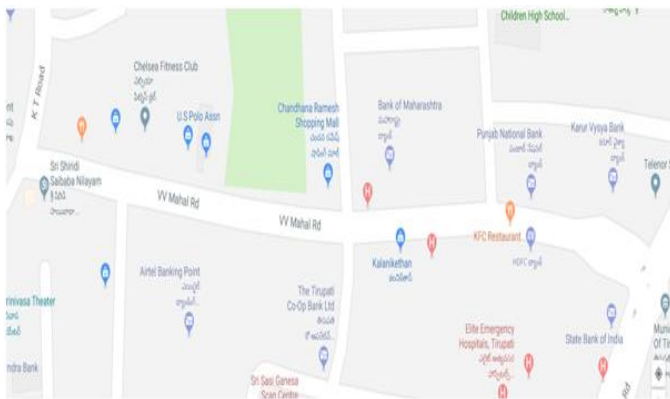


Fig : V.V Mahal Road Satellite image

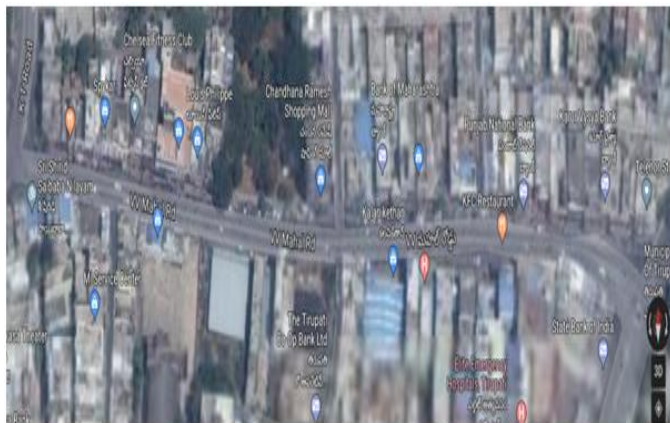


Fig : V.V Mahal Road Map

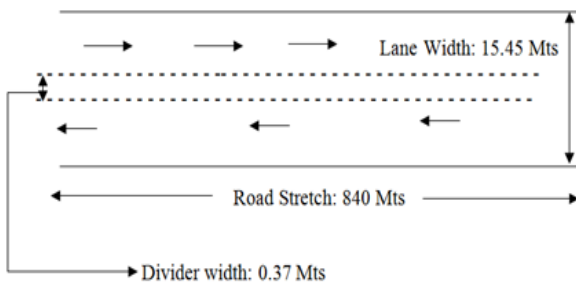


Fig Layout Sketch

**PARKING STUDIES**

Parking studies were carried out in the important roads of Tirupati. Important roads like Gandhi road, Tiruchanoor road, Prakasam road, V.V. Mahal road and Air Bypass road. In these major roads two of them are two-way divided carriage way with four lanes, other three are two-way lanes [15]. Data was collected using field data sheets and carried out by the trained persons. Parking was taken average of vehicles parked on the

roads for every 15 minutes. The values tabulated every slot is an average of four intervals.

Parking studies were carried with six slots all through the day.

Slot 1 = 8.00 AM – 9.00 AM

Slot 2 = 9.00 AM – 10.00 AM

Slot 3 = 10.00 AM – 11.00 AM

Slot 4 = 5.00 PM – 6.00 PM

Slot 5 = 6.00 PM – 7.00 PM

Slot 6 = 7.00 PM – 8.00 PM

**Vehicle Parking Demand:**

V.V. Mahal Road												
Type of Vehicle	Slot 1		Slot 2		Slot 3		Slot 4		Slot 5		Slot 6	
	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	
2 Wheelers	112	22.4	220	44	472	94.4	594	118.8	766	153.2	570	114
3 Wheelers	4	1.6	10	4	20	8	32	12.8	20	8	40	16
4 Wheelers	8	8	10	10	30	30	54	54	44	44	50	50
NMV	3	0.3	1	0.1	10	1	22	2.2	20	2	28	2.8
PCU	32.3		58.1		133.4		187.8		207.2		182.8	

Prakasam Road												
Type of Vehicle	Slot 1		Slot 2		Slot 3		Slot 4		Slot 5		Slot 6	
	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	
2 Wheelers	384	76.8	482	96.4	460	92	840	168	125	251	75	150
3 Wheelers	12	4.8	16	6.4	14	5.6	16	6.4	10	4	20	8
4 Wheelers	44	44	28	28	32	32	30	30	38	38	44	44
NMV	17	1.7	19	1.9	12	1.2	17	1.7	16	1.6	15	1.5
PCU	127.3		132.7		130.8		206.1		294.6		203.5	

Gandhi Road												
Type of Vehicle	Slot 1		Slot 2		Slot 3		Slot 4		Slot 5		Slot 6	
	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	PCU	
2 Wheelers	242	48.4	372	74.4	480	96	550	110	870	174	54	108
3 Wheelers	10	4	9	3.6	4	1.6	5	2	3	1.2	5	2
4 Wheelers	7	7	4	4	4	4	5	5	4	4	3	3
NMV	53	5.3	74	7.4	22	2.2	38	3.8	43	4.3	47	4.7
PCU	64.7		89.4		103.8		120.8		183.5		117.7	

Tiruchanoor Road												
Type of Vehicle	Slot 1		Slot 2		Slot 3		Slot 4		Slot 5		Slot 6	
	PC	U	PC	U	PCU	PCU	PCU	PCU	PCU	PCU	PCU	
2 Wheelers	30	60	55	110	676	135.2	858	171.6	914	182.8	108	216.0
3 Wheelers	74	29.6	64	25.6	56	22.4	50	20	40	16	56	22.4
4 Wheelers	13	130	10	108	84	84	54	54	50	50	74	74
NMV	25	2.5	29	2.9	85	8.5	27	2.7	40	4	45	4.5
PCU	222.1		246.5		250.1		248.3		252.8		316.9	

AIR Bypass Road												
Type of Vehicle	Slot 1		Slot 2		Slot 3		Slot 4		Slot 5		Slot 6	
	PC	U	PC	U	PCU	PCU	PCU	PCU	PCU	PCU	PCU	
2 Wheelers	148	29.6	378	75.6	378	75.6	720	144	598	119.6	76	153.8
3 Wheelers	14	5.6	22	8.8	26	10.4	32	12.8	34	13.6	34	13.6
4 Wheelers	18	18	22	22	30	30	76	76	82	82	76	76
NMV	3	0.3	10	1	9	0.9	11	1.1	13	1.3	13	1.3
PCU	53.5		107.4		116.9		233.9		216.5		244.5	

**Note:** Here PCU means PCU in parking.

**Parking accumulation survey**

The parking accumulation data collected from parking accumulation and duration surveys carried out for on-street and parking areas within the influence area were compiled and analyzed to work out the accumulation and duration of parking. Supply and accumulation analysis results for the base year have been tabulated in Table.

**Table No. 3 Supply and accumulation analysis results**

S.No.	Parking Lot (Area)	Supply of Spaces	Morning			Evening		
			Morning Occupied	Surplus & Shortfall of Spaces	Accumulation / Supply	Evening Occupied	Surplus & Shortfall	Accumulation / Supply
1	V V Mahal Road	234	133	+101	0.56	207	+27	0.88
2	Prakasam road	131	133	-2	1.01	295	-164	2.25
3	Gandhi Road	176	104	+72	0.59	184	-8	1.04
4	Tiruchanoor Road	393	250	+143	0.63	317	+76	0.80
5	AIR Bypass Road	220	117	+103	0.53	245	-25	1.11

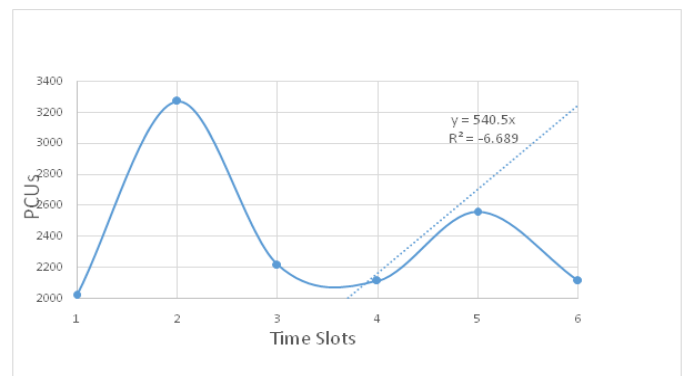
**TABLE 4. PARKING TURN-OVER RATE**

S.No.	Parking Lot (Area)	Supply	Number of different vehicles utilizing parking space in a period of 12 hours	Parking Turn-Over
1	V V Mahal Road	234	1548	6.61
2	Prakasam road	131	827	6.31
3	Gandhi Road	176	1214	6.89
4	Tiruchanoor Road	393	1197	3.04
5	AIR Bypass Road	220	771	3.50

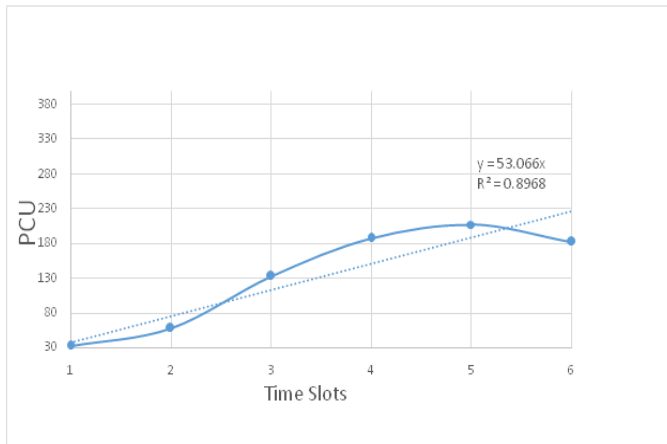
**Temporal patterns**

It was observed that parking search varied according to time of day, day of the week, and time of year, with peak parking times (not always aligned with peak traffic times) affecting the likelihood of parking search, such as in Gandhi road during evenings after 6 p.m., when on-street parking becomes most demandable. Morning periods were identified across all streets as generally having more parking search occurrences for shopping and business purposes, while evenings generated search for entertainment and social purposes. In Gandhi road and V.V.Mahal road as commercial shops are very more it is observed that parking requirement is being drastically increasing over time and date. While on Saturdays and Sundays when usual visitors become more for shopping, business, and commuting purposes were augmented by a large number of market visitors: “market days are very busy...search for parking may occur on these days”

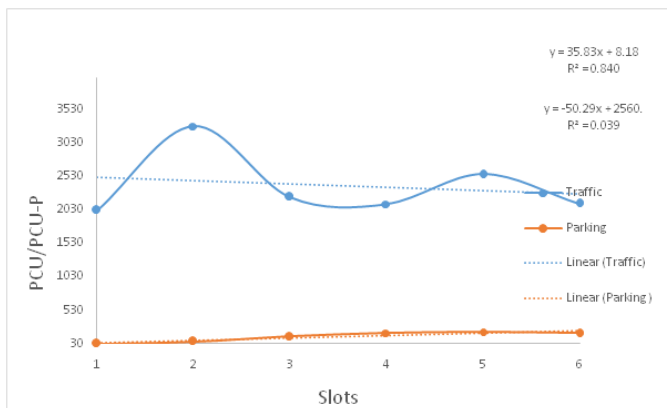
**VV MAHAL ROAD**



**Variation of Traffic Volume with Time**



Variation of Parking Volume with Time



Variation of parking and traffic volumes with time

**Recommendations for improvement of various roads**  
**V.V.Mahal road:**

S.No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	15.45	11.33	0.84	-	3.75	4	0.37
						2 - Way w/divider	

The best options for this road can be:

- 1) Widening of the road
- 2) Creating the paid off street parking system
- 3) Introduction of the paid on street parking and
- 4) Restriction of 3 or 4 wheelers and heavy vehicles during peak hours

**Prakasam Road:**

S.No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	12.62	11.24	0.51	-	0.9	2	0.48
						2 - way w/divider	

The best options for this road can be:

- 1) To create paidoff street parking system for vehicles especially 3 and 4 wheelers and for the two wheelers which are parked for longer duration and
- 2) Restriction of 3 or 4 wheelers and heavy vehicles during peak hours

**GANDHI ROAD:**

S.No	Width (in Meters)	Single Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	13.74	11.05	0.62	-	2.69	4	-
						1 - Way	

The best options for this road can be:

- 1) Creation of paidoff street parking system
- 2) Introduction of the paid on street parking and
- 3) Restriction of 3 or 4 wheelers and heavy vehicles during peak hours

**TIRUCHANOOR ROAD**

S.No	Width (in Meters)	Dual Carriage way Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	23.27	18.8	1.30	-	2.77	6	1.7
						2 - Way w/divider	

The best options for this road can be:

- 1) Introduction of paid on street parking
- 2) Creation of paid off street parking system

**AIR BYPASS ROAD**

S.No	Width (in Meters)	Lane Width (in mts)	Stretch (in Kms)	Gradient (in Degrees)	Shoulder Width (Mts)	No. of Lanes	Divider Width (Mts)
1	17.39	13.6	0.76	-	2.69	4	1.1
						2 - Way w/divider	

The best options for this road can be:

- 1) Creation of paidoff street parking system
- 2) Introduction of the paid on street parking and
- 3) Widening of the road

**CONCLUSIONS**

In this project the commute travel effects of on street parking area in five major streets of Tirupati, Andhra Pradesh, India. The various facts and finding of the study can be listed as under:

- A) All the five parking sub-areas are fully packed to their capacity and are in-fact over loaded in many cases with 3\4 wheelers group
- B) The parking turnover rate varies from 3.04 to 6.89 percent of all the five streets.
- C) At present the demand is excess as the ratio of parking supply to maximum demand is less than one (<1) for all the 2-wheeler parking's and it is more than 1 in case of two roads considering three and four-wheeler parking.
- D) The peak accumulation in all the five parking sub-areas is about 2.25 percent of the total accumulation.
- E) The heavy accumulation is in the time period of 05:00 pm to 8:00 pm, and the peak hour is generally 6:00pm - 7:00 pm in all the cases.
- F) Parking congestion is observed to be 37 to 50 percent. Highest space occupied was about 53.42 % in some streets allowing restriction to traffic flow.
- G) Willingness to pay survey revealed that only 33% of people interviewed were willing to pay the prices fixed.

**RECOMMENDATIONS**

Based on the analysis and conclusions some of the recommendations are recommended which are mentioned below:

- A Parking Audit should be conducted of existing buildings and land uses by a team especially constituted for the same, to determine the actual parking demand for the type of building / land use.
- The TUDA Rules need to be amended accordingly. Any new development should be mandated to submit an Impact Statement, clearly setting out the impact it will have on all urban infrastructure, especially the transport infrastructure.
- The parking charges should be levied to reflect to some extent the real estate values of the locality.
- On-street parking should be minimized, especially on arterial roads to avoid traffic congestion.
- Parking restrictions are to be enforced forcefully, and traffic police will need to be empowered to do.

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